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Nonstructural Materials experts evaluate lubrication

by Timothy R. Anderl, Materials and Manufacturing Directorate

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — Discoveries from research and analysis conducted by experts from Air Force Research Laboratory's Materials and Manufacturing Directorate (ML) of a grease lubricant used in the B-2 aircraft have led to longer intervals between grease lubricant maintenance, which will result in significant cost savings for the Air Force.

By inspecting the operational life of the lubricant, ML researchers made recommendations to the B-2 Systems Program Office (SPO) that allowed them to extend the lubrication maintenance interval for flight controls and flight control actuators from every 600 hours to every 1,000 hours, a 67 percent extension. The application of the new intervals provides cost savings of \$7.2 million over 20 years of aircraft operation, including costs associated with 60,000 hours worth of unnecessary maintenance and aircraft down time.

Lubricants are used to minimize corrosion, wear and failure in areas where moving metal components perform or interact with each other. During the operational life of a lubricant, oil evaporation and exposure to oxygen and water can change the physical and chemical properties of a grease, and make it less effective. In addition, grease sometimes becomes contaminated with wear or elastomeric seal debris, which changes the consistency of the lubricant and negatively affects the performance of the system where it is applied. These catalysts make regular maintenance of grease lubricants necessary.

"When working properly, a grease enables the long-term performance of Air Force technologies," said Lois Gschwender, a lubricant specialist working in the directorate. "Grease keeps parts moving and keeps wear down, which often results in improved system performance, minimized failures, and, in this case, cost saving benefits."

Researchers from ML's Nonstructural Materials Branch, who conduct research and development on nonmetallic, nonstructural materials such as fluids, oils greases and solvents, received a request from the B-2 SPO to compare and analyze the effectiveness of the lubricant grease, MIL-PRF-23927, during regular and extended maintenance intervals.

"The SPO wanted to safely extend the amount of time the aircraft could operate between maintenance down time," Gschwender said. "So we examined, compared and analyzed new, unused grease with grease that had 600 and 1,200 hours of operation life."

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Dr. Shashi Sharma (pictured on left) and George Fultz (not pictured), researchers from ML's Nonstructural Materials Branch inspected bearings to evaluate the performance of lubricants and their impact on real world systems. Dr. Lois Gschwender (pictured on right) and Ed Snyder (not pictured), analyzed grease samples using microscopy.

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Grease samples from four aircraft, which were in maintenance inspections, were analyzed by researchers using microscopic and infrared spectroscopic techniques. ML researchers discovered that while “used” greases had a slightly harder consistency and darker color than new grease, they were not contaminated with wear or seal debris. In addition, the consistency of the grease indicated that several of the major failure modes of grease, including thermal and oxidation degradation, reaction of the base oil with water, and evaporation of base oil, had not occurred.

“We concluded that the grease was suitable for continued use, had significant life remaining, and didn’t need to be checked or replaced every 600 hours,” Gschwender said. She added that researchers from ML reported their results during discussions with the SPO and Northrop Grumman, the aircraft’s manufacturer.

Representatives from Northrop Grumman; Rexnord Shafer, a bearing manufacturer; and ML also conducted an analysis of bearings from flight control actuators that had operated for 38 and 40 months using the grease. With more than 800 hours since their last maintenance, the bearings appeared to be “shiny” and showed no signs of damage. Though some insignificant corrosion and wear marks were observed when examined under magnification, researchers concluded that the bearings were suitable for continued use in the aircraft.

“(We) researchers from all the involved organizations were in agreement that the grease and bearings were performing beyond the current lubrication maintenance schedules,” Gschwender said. “This allowed the SPO to make a positive change to their day-to-day responsibilities, and to save the Air Force a substantial amount of money.” @